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EXPERIMENT STATION

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A DISEASED LEAFLET (Magnified 4 times)

THE SEPTORIA LEAF SPOT DISEASE OF CELERY OR CELERY BLIGHT

BY G. H. COONS AND EZRA LEVIN

The Michigan celery industry lost probably more than a million dollars in 1915 from the disease called Septoria Leaf Spot or "Blight". This loss could have been entirely prevented had proper methods been used. This bulletin explains the cause of this disease and tells how to prevent it. It is written for the small grower, but producers with large acreages can easily adapt the recommendations to their conditions.

EAST LANSING
1916

THE SEPTORIA* LEAF SPOT DISEASE OF CELERY

HOW TO TELL THE DISEASE.

Brown leaf spots specked with black dots are signs of the disease.

Septoria leaf spot or "Blight" shows first as brown, dead spots on the leaves. These spots are soon specked with dots which, though small, are easily seen with the naked eye. (See frontispiece.) With light attack there may be only a few spots on the leaves, and the celery bunches are only slightly disfigured. In a weak market, buyers cut the price 5 to 10 cents per crate for this condition of the tops. However, with severe attack, the leaves wither and die, and the stems merely shrivel and fall down. The

FIG. 2.—The diseased leaves in early and late stages.

disease begins on the older, outer leaves, passes to the inner and heart leaves, until no salable part is free from the trouble. The rotting celery has a characteristic odor. Severe attack means worthless celery, since the bunches will not keep in market or storage.

THE CAUSE OF CELERY LEAF SPOT.

A mold steals from the celery plant.

Celery leaves show such spots and the stems rot because of the attack of a parasitic fungus. *A parasitic fungus, or mold, is a small plant that steals its living from another plant.* These parasitic fungi consist of threads so small that a microscope is necessary for one to see them. The threads of this fungus twine between the leaf cells and feed upon the cell substances. Just

*Called Septoria leaf spot because the disease is caused by a fungus, *Septoria apii.*

as the larger plants are spread by seeds, these microscopic plants are spread by small bodies which do the same work as seeds. *These bodies are called spores.* The spores of the celery leaf spot fungus are needle-shaped and are only about 1-250 of an inch long. They cannot be seen with the naked eye. These spores are produced in immense numbers inside the black bodies found on the diseased spots on the leaves.

Spores are the "seeds" of the fungus.

FIG. 3.—Section through diseased spot, showing fungous threads penetrating leaf tissue and spore case with exuding spores; enlarged view of spores at right. (Diagrammatic.)

The spores are sticky and when the diseased leaf is wet they ooze out of the black spore case. These spores float about the leaf in the dew. The chief spreading comes from the washing and splashing by rain. When the leaves are dry the spores dry down. Therefore, the fungus spreads only when the leaves are wet.

Dew and rain carry the spores, spreading the disease from leaf to leaf.

When a spore (compare with a seed) is washed to a leaf and the leaf stays wet long enough (several hours) the spore sprouts by sending out several tubes. These sprouts grow into the celery leaf and continue to grow inside by sending threads through the tissue. After about nine days (varying with the temperature) a well-marked spot may be seen on the leaf. In about 15 to 20 days the spots show many black spore cases and a second crop of spores is produced. In this way one spore produces, in less than three weeks, millions of others, each of which is capable of producing millions more. It is little wonder that fields can be completely blighted.

The parasite enters the leaf.

One spore quickly produces millions of others.

WHERE THE FUNGUS COMES FROM EACH YEAR.

The fungus lives over winter on the trash from diseased plants. Nearly all samples of celery seed carry the fungus. The old seed hull is carried above the ground by the growing leaves, and spores from diseased seeds wash to the young leaflets. In this way some

The fungus lives over on the trash and seeds.

plants in the seed bed may have diseased spots and carry the fungus to the field. A few heart leaves may be infected by splashings of rain from the trash of last year's crop.

FIG. 4.—Celery seed showing fruiting bodies of the fungus; seed at left, healthy.

HOW THE DISEASE SPREADS IN THE FIELD.

Spores are carried from wet plants.

The spores from these diseased plants are splashed by rain down to the heart leaves and to neighboring plants and thus a "nest" of the disease arises. *Cultivation when the plants are wet will spread the disease along the row.* The spores are not killed by several days drying, so that when spread they may remain alive until the leaves are wet again. A heavy dew that is slow drying, may keep the plants wet long enough to allow the spores to sprout and get into the celery leaves. Fields that are sheltered from the wind, or poorly drained, or with rows extremely close, invariably suffer most from this disease. *Any condition that keeps the plants from drying quickly or causes the soil to stay wet long favors the leaf spot.*

Drainage and ventilation keep down this disease.

SEPTORIA LEAF SPOT AND THE WEATHER

Simple proof that the **fungus,** not the weather, causes this disease.

Many growers believe that the weather causes this disease. If this were true we could not hope to do anything to fight the disease, since we cannot control the weather. *The fact is, that without the fungus, no matter what the weather, we would not have this disease.* The proof of this is simple. If we put two healthy celery plants under wet conditions and on one put some spores of this fungus, while the other is merely kept wet, *only the plant with the spores becomes diseased.* If wet conditions caused the disease, both should become sick. Wet weather makes this disease severe by allowing the spores to be spread over the field and by giving the right conditions for the spores to sprout and bore into the plant. Weather does not cause this kind of a plant disease. *Growers must learn to get a crop in spite of the weather.*

Get a crop in spite of the weather.

HOW TO FIGHT CELERY BLIGHT.

A few diseased seeds are found in nearly all lots of celery seed.

Disinfect the seed before planting. Soak the seed ½ hour or longer in warm, but not hot, water. Then soak ½ hour in corrosive sublimate 1 part to 1000 of water. This solution, already prepared, can be obtained from the druggist at about 10 cents a pint. It can be made by dissolving 4 small (or one large) corrosive sublimate antiseptic tablets in a pint of water. *Corrosive*

sublimate is deadly poison. It must not be used in metal dishes. Keep the solution or the tablets out of the reach of children. Corrosive sublimate may cut down germination slightly.

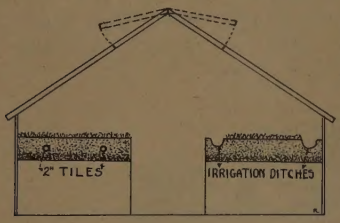

FIG. 5.—Diagram of greenhouse showing at left 2-inch tiles placed for sub-irrigation, and at right two small ditches through which water can be flooded.

Spores are usually dead on seed two or three years old. *The use of old seed of good germinating power is to be advised.*

Irrigate the seed beds by gently flooding or place tile for sub-irrigation. *Do not water heavily.*

Sprinkling may spread the fungus in the greenhouse.

If land enough is available, *rotate crops.* This method is best for the land, keeps down weeds, and is the cheapest and best way to fight all celery diseases. Put new, clean soil in the greenhouse—don't use old celery soil*. *Rotate the seed bed,* but do not put it where celery stood the year before. *Do not mulch the seed bed with old celery tops.* Leave no celery trash about in the seed beds.

The fungus lives over winter in the trash of last year's crop.

Cultivate the dirt away from young celery plants so as to expose the crown. This allows the leaves to spread and helps to keep the heart leaves clean.

The spores are splashed and washed from diseased spots on the leaves to the heart leaves.

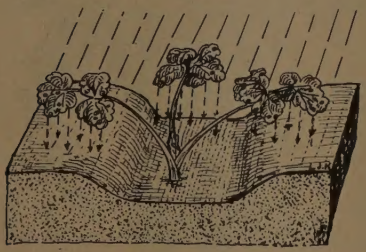

FIG. 6.—Right way to cultivate: Dirt thrown away from plant, crown exposed. The drip from the leaves does not fall into the heart.

FIG. 7.—Wrong way to cultivate: Dirt banked up on young plant. The drip from the leaves falls on the young heart leaves.

Do not work plants while the dew is on or directly after a rain. To do this carries the fungus along the row on the cultivator or on the worker's clothes.

The spores are easily spread when the plants are wet.

*Old greenhouse soil can be made safe by steam sterilizing. Chemicals to drench the soil may also be used. Use formaldehyde 1 gallon to 50 gallons water. Pour on as much as the soil will hold (about a gallon to the square foot). Stir the soil thoroughly as the chemical is applied. Cover with paper or canvas over night. Then work the soil each day till it dries and the fumes escape. From three days to a week will be necessary to get the soil into shape. All boards, paths, tools, etc., must also be drenched with the disinfectant. **This treatment of greenhouse soil is aimed more at soil diseases than at leaf dseases.** Two gallons formaldehyde (cost $2.00) will treat 100 sq. ft.

Slow drying allows the fungus to get into the leaves.

Drain the land well. Keep the ditches clean. Do not locate celery fields in hollows or in places surrounded by trees or buildings. Do not pile boards so as to shelter the rows from the wind. *Ventilation is essential for quick drying.*

Spray celery as a matter of crop insurance.

Spray the celery plants every two or three weeks with home-made Bordeaux mixture prepared *exactly* according to directions. *Spray oftener if the season is as wet as the past one.*

FIG. 8.—Sprayed and unsprayed celery from the Muskegon experiment.

Bordeaux Mixture is a protective coating.

Bordeaux mixture is a preparation poisonous to fungi and is used to give plants a protective coat. It is simply a *dilute* solution of Bluestone (or Blue Vitriol), 2%, mixed thoroughly with a dilute milk of lime (2% Stone Lime), applied at once. (Fig. 9). The Bordeaux must be on the plant before the danger period. Therefore spray before rains. The Bordeaux, if allowed to dry for a half hour will not wash off. Use home-made Bordeaux, since it is cheaper and better than the commercial product. Celery does not need any lead arsenate or Paris Green. *Lime-sulphur is worthless for celery*—the blight spores can grow in this spray.

Keep the new growth covered with the spray.

A leaf sprayed once is protected as far as the Bordeaux reaches. The leaves increase in size, thus exposing new, tender surfaces.

New leaves keep coming. *To protect the new growth, spray often.*

The Sprayer.

For 1 or 2 acres a knapsack sprayer will do (cost about $5.00). A barrel pump (to run on boards) will cut down the work of spraying. This requires one man to pump and one to spray. (Cost about $50.00). Large acreages should have a *traction* or power sprayer (cost about $100.00 and up). The higher the pressure the finer is the mist produced, and the better the protection. *A small sprayer is better than none.*

Does spraying pay?

The College experiments of last summer at Muskegon demonstrate the value of spraying. The crop of celery harvested from the experimental field was the only celery of good quality harvested about Muskegon last fall. (Fig. 8) The following is the report of Mr. Joldersma, on whose farm the spraying was done:

One-sixth acre (from which accurate returns were kept) sprayed with a knapsack sprayer at a total expense of $2.00 for labor and material gave 125 crates (10x10) fine quality at $1.00 value	$125.00
A similar unsprayed area gave 18 crates poor quality at 50c.	9.00
Excess return of sprayed plot	$116.00
Cost of spraying	2.00
Net gain	$114.00

On the rest of the acreage, at an expense of not more than $12.00, Mr. Joldersma saved a crop valued at about $1500.00.

Mr. T. F. Spellman, Decatur, Mich., reports:

Sprayed six acres with a horse-drawn traction sprayer, using 40 pounds Blue Vitriol and 40 pounds lime. Labor account was not kept, but was probably not more than $25.	
11 cars (about 2000 crates) celery receipts	$2195.55
Total expense—seed, fertilizer, spraying, total labor F. O. B. cars	440.98
Net value of crop	$1754.57

No check was run on this test, but from the fact that the crop about Muskegon, Kalamazoo and Decatur was almost a total loss, and from the appearance of the fields nearby, it seems safe to attribute the excellence of this crop to the spraying.

To the small grower.

Spraying and other practices outlined in this bulletin, in spite of cost, must be made a part of good celery growing.

Bluestone is high priced this year and hard to obtain at any price. Nevertheless, celery diseases must be fought if the grower is to be sure of a crop each year. Blight does not come every year but no one knows when the next outbreak will come. As a matter of safety the grower should follow the instructions given to *insure* a crop in spite of bad weather. *The saving of one crop will pay for 20 years spraying.* The Michigan Agricultural College will answer questions on celery diseases and will diagnose specimens *free of charge.* We invite correspondence on celery disease problems. Address Department of Botany, Experiment Station, East Lansing, Mich.

HOW TO MAKE BORDEAUX FOR SMALL ACREAGES.

(1) *Saw a 50-gallon barrel (vinegar or oil) and make two 25-gallon tubs.*

(2) *Put 2 pounds of Bluestone* (called also Blue Vitriol or copper sulphate) *in a cloth sack and hang over night in one-half a tub of water* (12½ gallons). Bluestone dissolves slowly. Hang it the night before so that the sack is just under the surface of the water.

(3) *Make a lime paste by slaking 2 pounds of fresh stone lime in one-half pail of water.* Stir this into the half tub (12½ gallons) of cold water. Hydrated lime (comes in sacks) will do but is not so good. Use 2½ to 3 pounds of hydrated if stone lime cannot be had. *Then follow directions of the picture. This method makes 25 gallons of spray.*

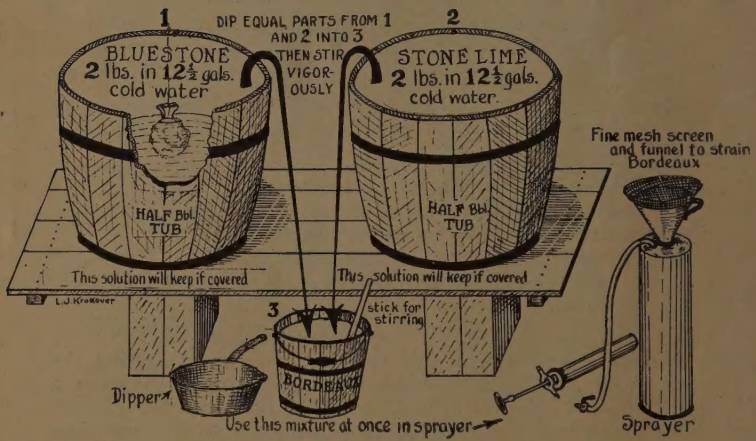

FIG. 9.—Good Bordeaux is easy to make if these directions are followed.

NOTE.—Where much Bordeaux is needed, use method of making a strong stock solution by dissolving 25 pounds of Bluestone in 25 gallons of water. Make a milk of lime using 25 pounds stone lime to 25 gallons of water. These stocks will keep. Then 1 gallon of stock carries 1 pound of Bluestone (or 1 pound of lime). To make 100 gallons of spray, dilute 8 gallons of stock Bluestone to 50 gallons, and 8 gallons of stock lime to 50 gallons and pour together. Bordeaux may be tested to determine if enough lime is present by means of blue litmus paper. If blue litmus turns red, add more lime. **With good lime, using the amounts given, no test is needed.**